PHILIPS RESEARCH / COVION / PIONEER

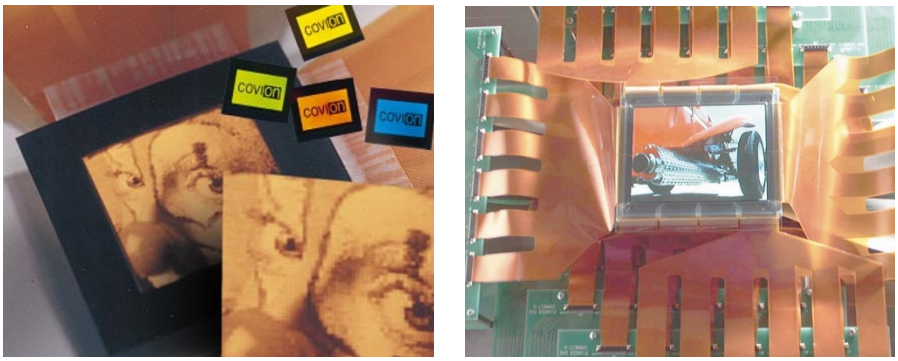

Figure 1 **Organics on display. The left panel (main image) shows a prototype monochrome dot-matrix display fabricated from an electroluminescent polymer (Philips). Products based on this technology should be released next year. Also shown are four unpatterned polymer displays (essentially backlights), illustrating the broad range of colours that are available (Covion Organic Semiconductors). The right panel shows a prototype full-colour display based on small-molecule electroluminescence (Pioneer).**

RON MOON, HEWLETT PACKARD

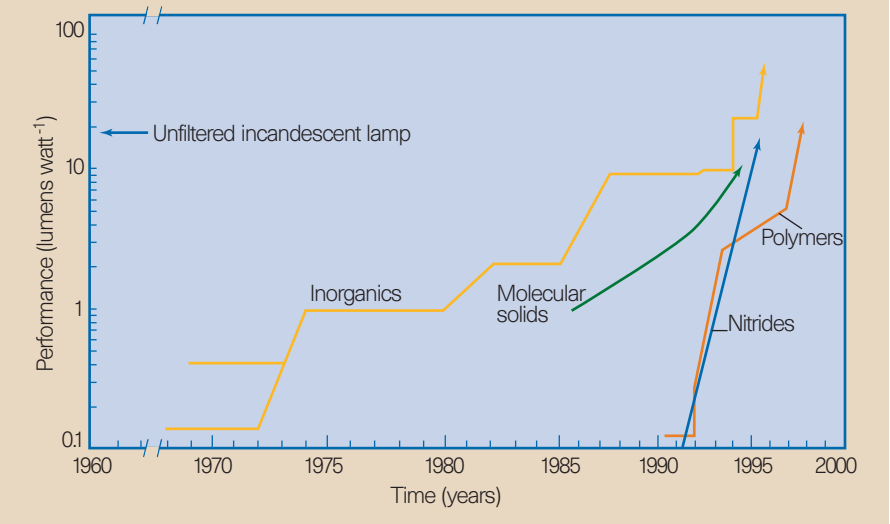

Figure 2 **Evolution of organic and inorganic light-emitting diodes (LEDs). Performance is in lumens per watt (a typical value for an unfiltered incandescent lamp is shown for comparison). Inorganic LEDs based on III-V semiconductors, such as gallium arsenide, arrived on the scene in the early 1960s, and their performance has shown steady but significant progress since then (yellow curve). Organic LEDs (green curve for the small molecules; orange curve for the polymers) appeared much more recently, yet are already approaching the best performance levels of their inorganic counterparts. The nitride-based semiconductors (blue curve) are another success story[5], and have extended applications of inorganic LEDs into the blue-violet part of the spectrum.**

(The introduction of zone-refining for the purification of inorganic crystalline semiconductors had a similar impact.) And chemists continue to design and synthesize new materials, with improved electrical and optical properties and overall stability: polyfluorene-based polymers look particularly promising (I. S. Millard, Cambridge Display Technology; M. Inbasekaran, Dow Chemical Company).

These improvements in efficiency and lifetime are already sufficient for the simpler applications (Fig. 1). For the polymers, several companies are well on the way to having products on the market, with monochrome backlights and segmented displays — such as those found on mobile telephones — promised by the end of this year (R.-J. Visser, Philips). High-resolution dot-matrix displays based on the small-molecule systems should be available even sooner (M. Shimura, Pioneer).

But the Holy Grail of virtually all display technologies is full colour, and the organics are no exception. With an ever-growing palette of materials at their disposal, researchers are racing to find ways to combine them effectively into a single display. To do so poses formidable challenges. The materials are generally better suited for the deposition of large-area, uniform layers rather than intricately patterned arrays of differently coloured pixels; and the emission colours (and efficiencies) of the individual pixels need to be carefully balanced to match the spectral response of the eye. For the molecular systems, vacuum deposition through a patterned 'mask' provides a

100 YEARS AGO

From the hottest to the coldest stars I have found ten groups so distinct from each other chemically that they require to be dealt with separately as completely as do the Cambrian and the Silurian formations. … I have gone further and defined the chemical nature of these stellar genera as the biologist defines the nature of any of his organic genera: we can say, for instance, that the Achernian stars contain chiefly hydrogen, nitrogen, oxygen and carbon, and to a certain less extent they contain proto-magnesium, proto-calcium, silicium and sodium, and possibly chlorine and lithium; so that at last, by means of this recent development of spectrum analysis, we have been able really to do for the various stars what the biologist a good many years ago did for the geological strata. … My point is that the more one inquires into the chemistry of these things the more we come back to the stellar point of view and to the fact that, taking the simplicity of chemical form as determined by the appearance of these different chemical substances in the hottest stars … and in relation to the "series" of spectra which they produce, we come to the conclusion that the first organic life was an interaction somehow or other between the undoubted earliest chemical forms.

From *Nature* 1 June 1899.

50 YEARS AGO

The question of drug resistance will require careful investigation … . Experiments at Entebbe indicate that strains of trypanosomes found in re-infected animals after the first treatment with 'Antrycide' may have considerable resistance to further treatment. This is illustrated by an experiment in which ten cattle were dosed with 2 gm. each of 'Antrycide' sulphate and were then exposed to trypsanosome infection in a *Glossina pallidipes* area. Only one was alive six months later … . In some cases, animals were re-infected some months after treatment with 'Antrycide' and re-treated with curative doses of 'Antrycide' sulphate have developed cryptic but nevertheless fatal infections. Should such cryptic infections or prolonged latent infections prove to occur frequently after 'Antrycide' treatment, an accurate estimation of the true duration of the prophylactic effect will be difficult.

From *Nature* 4 June 1949.